Prepared for:

P4 PRODUCTION
SOUTHEAST IDAHO MINE-SPECIFIC
SELENIUM PROGRAM

DRAFT

DIRECT-PUSH GROUNDWATER SAMPLING WORK PLAN
ENOCH VALLEY, HENRY, AND BALLARD MINES

REVISION 2

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF DRAWINGS

LIST OF APPENDICES

1.0 INTRODUCTION

This *Direct-Push Groundwater Sampling Work Plan* is a supplement to the *Monitoring Well Installation Technical Memorandum* (MWH, 2007a), and the two combined are presented in fulfillment of Activity 3b-5 of the *Final 2005 Phase II Supplemental SI Work Plan* (MWH, 2005; Phase II Groundwater Work Plan). The Phase II Groundwater Work Plan is an addendum to the *P4 Production Southeast Idaho Mine-Specific Selenium Program 2004 Comprehensive Site Investigation Final Work Plans for Ballard, Henry and Enoch Valley Mines* (MWH, 2004a) (2004 SI Work Plan).

The Phase I groundwater investigation tasks were presented in the 2004 SI Work Plan and were initiated in 2004 following approval from Idaho Department of Environmental Quality (IDEQ) and the other Agencies. The Phase I and Phase II groundwater investigations are being conducted in accordance with the requirements of the AOC signed by P4 Production, IDEQ, United States Environmental Protection Agency (USEPA), and United States Forest Service (USFS). This work supports the comprehensive mine-specific site investigations.

This work plan is part of the P4 Production response to a May 31, 2007 memorandum titled "Agency/Tribal Direction for Groundwater Characterization and Data Gap Analysis at P4 Production, LLC Enoch Valley, Henry, and Ballard Mine Sites, Idaho". On June 18 and 19, 2007 P4 Production and their consultant MWH Inc. met with agency and tribal representatives to discuss and come to resolution on items identified in the "Data Gap Memorandum". As part of these discussions it was agreed that a reconnaissance direct-push groundwater sampling program would be an acceptable next step in characterizing the shallow alluvial flow systems and would help address some of the data gaps presented in the memorandum. This program will develop screening or reconnaissance level data to help further refine the Conceptual Site Models and future investigation needs. The program should assist in developing a more efficient investigation of the alluvial groundwater systems present at the mine sites with fewer, more effectively placed, monitoring wells.

The overall groundwater investigation is being conducted in an effort to identify, characterize, and monitor groundwater flow systems associated with the potential contaminate sources at the P4 Production mines, with the final goal of defining risk and supporting the EE/CA process. This work plan presents a scope of work to specifically address the lateral extent of (potential) selenium impacts to shallow alluvial groundwater (i.e., Quaternary and older alluvium) downgradient of mine source components, such as the former mine pits and waste rock piles. The sampling in this work plan will be accomplished with samples of alluvial ground water from direct-push boreholes (e.g., Geoprobe®). This sampling is designed to augment monitoring data from the alluvial groundwater monitoring wells that are being installed as part of the current Phase II program (see *Monitoring Well Installation Technical Memorandum* (MWH, 2007a)).

The preliminary information obtained from Phase II activities and the results of sampling from the direct-push boreholes described in this work plan will be used to refine the site-specific conceptual hydrogeologic models and understanding of the lateral extent of selenium impacts in shallow (alluvial) groundwater. It should be noted that the term alluvial is being used in relation to the shallow groundwater system in unconsolidated sediments. In some cases the water-bearing sediment may be of colluvial and mixed origins.

This program was initially planned for the fall of 2007. However, results from the Phase II drilling program in the summer and fall of 2007 indicated relatively deep water tables in the alluvium, and at several locations the alluvium did not contain water bearing zones. Based on these observations, it appears that a direct-push sampling program in the fall would have had limited success. Much of the recharge to the alluvial system occurs in the spring as the result of snow melt. It has therefore been hypothesized that water levels will be seasonally elevated in the spring, which will result in more successful data collection attempts. Based on this, P4 and the agencies concurred on scheduling the direct-push program in the spring of 2008 (tentatively starting in April or May). Further, it is also likely that much of the selenium loading that occurs may be the result of the recharge event in the spring, providing further support for conducting the program in the spring.

2.0 SCOPE OF WORK

The scope of work included in this work plan consists of the following elements:

- Advancement of multiple direct-push boreholes to first encountered alluvial groundwater in the vicinity (downgradient) of mine source components (waste rock dumps and former mine pits) at the inactive P4 Production mines (Ballard, Enoch Valley and Henry; see Drawing 1, *Site Location Map*);

- Measurement of field parameters pH and electrical conductivity in boreholes that produce sufficient water to sample;

- If groundwater is encountered in the direct-push borehole, then a groundwater grab sample will be collected;

- Installation of prepacked well screens at select direct-push borehole locations to facilitate assessment of hydrogeologic characteristics of the shallow alluvial groundwater system;

- Assessment of in situ hydraulic conductivities (slug testing) at select direct-push locations; and

- Analysis of each groundwater sample for dissolved selenium.

A more detailed description of the scope of work is included below.

The direct-push boreholes will be advanced in two areas in the vicinity of the Enoch Valley and Henry Mines, as shown on Drawing 2, *Enoch Valley Mine and Henry Mine Groundwater Sampling Areas*, and three areas in the vicinity of the Ballard Mine, as shown on Drawing 3, *Ballard Mine Groundwater Sampling Areas*.

The direct-push boreholes will be advanced in two stages. The Stage 1 holes will be exploratory holes where soil cores will be extracted and logged followed by groundwater sampling, if groundwater is located. These holes will be used to evaluate the depth to first alluvial water and viability of the direct-push method in individual areas. Stage 2 boreholes will infill between and extend out from the Stage 1 boreholes. The Stage 2 boreholes will generally be advanced directly to groundwater where there is enough certainty in the hydrogeologic conditions. At some locations further coring may be necessary. In addition, prepacked well screens will be installed at select direct-push borehole locations. The majority of these locations will be selected based on hydrogeological character of the alluvial materials. For example, low yielding clayey sediments a large distance from the potential sources would not be a favorable location for the long-term collection of water quality data. However, both the need for longer term piezometric and water quality data will also be considered when selecting locations for installation of direct-push wells.

The goal for borehole spacing, where sampling collection is viable with the direct-push method, will generally be approximately 400 to 600 feet apart. Boreholes will be located where alluvial groundwater is most likely to be impacted (e.g., downgradient of the probable mine source components and other sampling stations where elevated selenium concentrations have been detected, as well as along creek beds where groundwater flow tends to converge) out to locations where it is expected to be below the maximum contaminant level (MCL) of 0.05 mg/L.

Direct-push borehole locations presented in this work plan are approximate. They are intended to illustrate the sampling strategy and be a guide for selecting locations in the field. Actual locations will be field located based on access to the location, surface conditions and geology, and probable flow paths based on observation of overall conditions. The types of alluvial sediments encountered will also be used to guide the program. If high permeability sediment is encountered, the sampling program may be extended downgradient. Conversely, the sampling program may be pulled closer to the potential sources if only low permeability material predominates. This concept is based on contaminant transport velocities. For very permeable sediments, velocities could be 100s of feet per year, opposed to lower permeability sediments were velocities may be a few feet per year. In all likelihood, the distribution of the boreholes will be per the drawing presented herein, unless permeabilities are estimated to be on the very high or low end of the typical range based on sediment types encountered.

2.1 EXISTING CONDITIONS

The drilling program conducted during the summer of 2007 indicated relatively fine-grained sediments without cobbles, and the alluvial sediments were observed to be un-cemented. These conditions are favorable for the direct-push sampling method (ASTM, 2005b). However, the sediments appear to be relatively dense, which may inhibit penetration. Groundwater was also generally encountered at depths deeper than may be possible to reach with direct-push methods in these sediments. The previous drilling indicates that the sediments are generally clay and silt, which even if saturated may not yield sufficient water for sampling with the small diameter direct-push boreholes. Table 2-1 summarizes the alluvial monitoring wells installed during the 2007 field program. The depth to groundwater and level of saturation should be more favorable in the spring when this program is planned.

The drilling program was optimized to identify and evaluate higher yielding groundwater zones (i.e., those most likely to transport significant quantities of potential contaminants from the source areas). Clay and silt accounted for much of the sediment, with some sand layers. In general, significant groundwater yield was only encountered in a confined zone at the weathered bedrock contact. Where weathering of clay-rich rocks (e.g., shale and mudstone) are the source of the unconsolidated alluvial and colluvial units, it is not an uncommon occurrence to have the highest shallow yields in the uppermost bedrock opposed to the clayey unconsolidated sediments. It is possible that with a more detailed evaluation of the alluvial sediments in the spring, shallower saturated zones will be identified. While these shallow zones do not represent a direct groundwater supply source, they may provide important information necessary to explain the migration of selenium away from potential sources to more significant groundwater zones.

TABLE 2-1
PRELIMINARY RESULTS FROM 2007 DRILLING PROGRAM IN DIRECT-PUSH INVESTIGATION AREAS

Monitoring Well	Total Selenium[1,2] (mg/L) Fall 2007	Direct-Push Area	Total Depth (ft-BGL)	Depth to Water Yielding Zone (ft-BGL)	Static Water Level (ft-BGL)	Sediment Geology
Enoch Valley Mine						
MMW007	0.002	A	90	88	40.7	Sandy clay, water yield in Dinwoody
MMW008	<0.001	A	197	160, 175	24.5	Silty clay, sand and gravel, water yield in angular gravel (160 ft-BGL) and Dinwoody (175 ft-BGL)
MMW012	NS	B	60	Dinwoody contact @ 60	Dry	Silty clay and Dinwoody
MMW013	<0.001	A	35	29	12.6	Dinwoody
Henry Mine						
MMW010	<0.001	C	31.5	17	15.4	Silty clay
MMW014	<0.001	C	22	9	2.9	Silty clay

Ballard Mine						
MMW017	0.130	F	57	35	32.8	Very-fine sandy clay
MMW018	0.029	D	33	31	11.9	Dinwoody
MMW15A(3)	1.99	E	45	Data Pending	21.3	Alluvium
MMW16A(3)	0.049	E	35	Data Pending	8.3	Alluvium

Notes:
(1) - Results are preliminary and are not validated. Therefore, they are being used semi-quantitatively to guide development of this plan.
(2) - Selenium MCL = 0.050 mg/L
(3) - Installed as part of a separate November 2006 investigation by Whetstone for the Blackfoot Bridge EIS.
NS - Not Sampled

2.2 DIRECT-PUSH BOREHOLES

2.2.1 Enoch Valley Mine

There are two areas where alluvial groundwater sampling is planned in the vicinity of the Enoch Valley Mine, as shown on Drawing 2, on the southern and northern ends of the mine, respectively. Of these areas, the southern Area A is more complex with three drainages containing potential source materials. The northern Area B has one large and one smaller drainage area to be evaluated. It appears that the majority of the potential surface and subsurface alluvial impacts would be directed to one of these two areas. The geology to the west and east is generally dominated by bedrock.

Approximately 25 boreholes are proposed for the first area (Area A), as shown on Drawing 4, *Locations of Direct-Push Sample Locations, Enoch Valley Mine, Area A*. Eight of these are Stage 1 exploratory boreholes. These boreholes are located northeast, east and southwest (downgradient) of the toe of waste rock dump MWD092, and to the southwest along Rasmussen Creek. Several boreholes are located along the southeast to southwest edge of the waste rock dump, and are located near MMW007, MMW008 and MMW013. Each of these wells was installed at or in the Dinwoody Formation, because at the time of drilling, the alluvium did not produce groundwater. Total selenium concentrations in these wells were not detected to 0.002 mg/L (Table 2-1); however, the direct-push program will evaluate the shallow alluvial zones, if water is located. The Stage 1 boreholes near these wells will be used to confirm the level of saturation in the shallower alluvium during the spring recharge period. Water levels in the monitoring wells will help guide the direct-push evaluation, although it appeared that the zones monitored by the wells are at least semi-confined due to clay layers in the upper Dinwoody Formation. If shallow alluvial groundwater is encountered in the vicinity of MMW007 or MMW008 one proposed Stage 2 borehole will be completed as a prepacked monitoring well within the Dinwoody Formation, if practicable. If a separate zone of shallow alluvial groundwater is encountered in the vicinity of the Stage 2 borehole, a second prepacked monitoring well will be installed in the shallow alluvial zone to assess the vertical component of groundwater flow between the alluvium and the Dinwoody Formation.

In the vicinity of MST136, one Stage 1 and one Stage 2 borehole will be advanced to assess the extent of potential selenium contamination in the shallow alluvium.

Tentatively, approximately 12 boreholes are proposed in the second area in the vicinity of the Enoch Valley Mine, as shown on Drawing 5, *Locations of Direct-Push Sample Locations, Enoch Valley Mine, Area B*. Five of the boreholes will be Stage 1 boreholes. These boreholes are located in alluvium material west of waste rock dump MWD091, downgradient of the new monitoring well MMW012. Three seeps were identified on previous mapping, and boreholes are located near these seeps. However, these seeps have never been sampled, because there never has been observable flow or wet areas. Nonetheless, the mapping of springs in this area at some point suggests that some further reconnaissance of the area using the direct-push sampling is warranted.

Similar to Area A, indications from MMW012 is that shallow alluvial groundwater may not be present. However, the direct-push program will be used to investigate the level of saturation in the alluvial system during the spring recharge period. Select Stage 2 direct-push borehole locations in the vicinity of MMW012 may be completed as monitoring wells using prepacked well screens to assist in assessing potentiometic surfaces in the vicinity of MMW012. Slug testing may also be completed to assess the hydraulic conductivities of the aquifer material in the vicinity of the direct-push borehole.

2.2.2 Henry Mine

Several boreholes are proposed in the vicinity of the Henry Mine (see Drawing 2, Areas C and D). At this time, selenium in excess of the MCL of 0.050 mg/L has not been detected in the alluvial system at the Henry Mine, including the new alluvial wells which both had concentrations below the detection limit of 0.001 mg/L in the fall of 2007 (Table 2-1).

Four Stage 1 exploratory boreholes will be installed. One of these is located to the southwest of the toe of the valley-fill waste rock dump MWD087, as shown on Drawing 6, *Locations of Direct-Push Sample Locations, Henry Mine, Area C*. Five Stage 1 and 2 boreholes are located in the area of monitoring wells MMW010 and MMW014, which were installed as part of the Phase II activities, to confirm the distribution of selenium impacts between those two monitoring wells. This includes one borehole sampling point collocated with MMW014. Selenium was not detected in MMW014, and the downstream direct-push hole may help confirm the limited extent in this area. A Stage 1 and Stage 2 borehole will be placed in the small drainage west of the southeast end of MMP042. This is the historic channel draining the southern end of the central Henry Mine area. These locations will be upstream of the location below MWD087 described above.

Area D will include five boreholes along a tributary to the Little Blackfoot River upstream of monitoring wells MMW011 and MMW019 (Drawing 7, *Locations of Direct-Push Sample Locations, Henry Mine, Area D).* This area has not previously been sampled.

Additional direct-push boreholes will be advanced north and south of the Little Blackfoot River in the vicinity of MWD085 and MWD086. However, the boundaries of alluvial material and waste rock in this area are uncertain. In addition, basalt underlies much of the area and some channels are incised in the basalt with only thin alluvial deposits. Therefore, the borings will be located following a reconnaissance of the area. Generally the locations will be as follows:

- An additional potential direct-push borehole will be advanced to assess potential selenium impacts in the area southeast of MSP015 up the drainage that divides the east and west portions of MWD086.
- To assess potential flow paths from MMP041 and MWD085 southeast to the Little Blackfoot River, two direct-push boreholes will be advanced. These locations are in the basaltic area shown on the Area D figure.
- If needed, one Stage 1 direct-push borehole will be advanced to evaluate potential connectivity from Pond MSP016 to the Little Blackfoot River (Drawing 7, *Location of Direct-Push Sample Locations, Henry Mine, Area D*). However, the exact position of MSP016 will need to be verified and it may be that one of the existing direct-push borehole locations may address this data need.

Throughout the Henry Mine area, select direct-push borehole locations may be completed as monitoring wells using prepacked well screens to facilitate gathering longer-term piezometric and groundwater quality information. Slug testing may also be completed to assess the hydraulic conductivities of the aquifer material in the vicinity of the proposed direct-push borehole locations. Locations for prepacked well screen installation and slug testing will be selected based on suitability for the alluvial material and strategic importance of the location (e.g., a lateral location may be given less consideration for long-term monitoring using a prepacked well screen compared to a location in the flow path).

2.2.3 Ballard Mine

Because of the Ballard Mine's topographic and geologic location there are comparatively more potential alluvial pathways near the mine. There are approximately 63 potential boreholes identified in the Ballard Mine area.

There are 24 potential locations for the area on the east side of the Ballard Mine (see Drawing 8, Area E). The one monitoring well located in this area (MMW018) reported a selenium concentration of only 0.029 mg/L in the uppermost Dinwoody Formation; however, several springs exhibit higher concentrations. The Area E boreholes will be advanced within the alluvium to the northeast and east of waste rock dump MWD082, as shown on Drawing 8, *Locations of Direct-Push Boreholes, Ballard Mine, Area E*. Boreholes will also be located downgradient, southeast, of the MWD084 waste dump and mine pit MMP039. These boreholes are specifically located to evaluate the lateral extent of selenium impacts in the vicinity of spring fed stream locations MST094, MST095 and MST096, as well as springs MSG004, MSG005, and MSG006, from which elevated selenium concentrations (greater than 0.01 mg/L) have been detected historically (MWH, 2007a). The boreholes will be located along apparent channels leading from source areas. One borehole will be collocated with MMW018 (approximately 5 feet laterally). Four of the boreholes will be Stage 1 holes to confirm the presence of groundwater and characterize the sediments in individual channel areas. Three boreholes will be located near waste dump MWD084 to evaluate the impacts in that area.

Approximately 21 potential borehole locations are proposed for the area southwest of waste rock dumps MWD080 and MWD081 (see Drawing 3, Area F, and Drawing 9, *Locations of Direct-Push Boreholes, Ballard Mine, Area F*). The boreholes will be advanced within the alluvium near and downgradient of the spring fed stream locations MST067, MST068 and MST069, and the new monitoring wells MMW15A and MMW16A. Water levels in this area, as measured in MMW15A and 16A, range from approximately 7 to 23 feet below the ground surface. Four of the locations will be Stage 1 boreholes. Two direct-push boreholes will be advanced in the alluvium south of waste dump MWD083 and mine pit MMP036. Positioning of these locations will require addition field reconnaissance because of the limited alluvial channel width in this area.

Approximately 18 potential boreholes are proposed on the west side of the Ballard Mine, west of MWD080 (see Drawing 3, Area G, and Drawing 10, *Locations of Direct-Push Boreholes, Ballard Mine, Area G*). These boreholes will be advanced in the older alluvium west of the waste rock dump, and to the north and south of the new monitoring well MMW017, which had a total selenium concentration of 0.13 mg/L during the Fall 2007 sampling event. Five of the locations will be Stage 1 boreholes. Based on recent observations made during drilling for the new well MMW017, it appears as though groundwater may be as deep as 30 feet below ground surface in this area in the fall season.

Throughout the Ballard Mine area, select direct-push borehole locations may be completed as monitoring wells using prepacked well screens to facilitate gathering longer-term piezometric and groundwater quality information. Slug testing may also be completed to assess the hydraulic conductivities of the aquifer material in the vicinity of the proposed direct-push borehole locations.

2.2.4 General Considerations and Scheduling

Several boreholes will be advanced within the areas of the Enoch Valley, Henry and Ballard Mines described above, if conditions are appropriate. As noted above, the locations depicted in the drawings indicate general locations and indicate the approximate extent and strategy for sampling. Locations may be adjusted and additional boreholes may be advanced or currently proposed ones may be deleted based on observations made while in the field and during drilling, such as areas where alluvium exists or does not exist. The available mapping is relatively general and alluvial contacts are not precisely located; therefore, field observations will be heavily relied upon. Other factors that may affect borehole placement include physical and property owner access, depth to water and sediment permeability. For example, if water is located in high permeability alluvial sand and gravel, sampling may be extended further downgradient. Generally, boreholes will be located along alluvial depressions on the assumption that groundwater will be more likely reachable with the direct-push system in these areas, and that they represent likely locations for alluvial flow pathways.

The timing of the sampling is important. The program should not be conducted during the snowmelt event, but shortly thereafter. From a practical consideration, during snowmelt ground conditions may be too wet for accessing some locations. However, following the snowmelt event there is also likely to be a time lag until the peak in the groundwater levels is observed. The direct-push program will be targeted for late-April to early-May. However, observations for the sites regarding ground conditions and runoff will be important for timing the event.

2.3 CHEMICAL ANALYSIS

A groundwater sample will be collected from each borehole drilled at the locations described in Section 2.1. Each sample will be tested in the field for pH and electrical conductivity. The samples will then be submitted to a chemical laboratory for analysis of selenium. Direct-push boreholes typically yield small quantities of turbid groundwater at low inflow rates. If the boreholes yield sufficient water they will be pumped or bailed in an attempt to develop the sampling point and produce less turbid water. However, because the direct-push groundwater samples will likely have variable levels of relatively high turbidity, all samples will be field filtered, acidified, and submitted to the laboratory for dissolved selenium analysis. If this were not done, individual samples would not be comparable because the variable concentrations of suspended sediment would have an effect on the total selenium concentration. Total analysis would therefore add an additional variable that would limit the ability to compare sample points. Filtering will remove the variable associated with mineral and sorbed selenium in the water sample. The samples are used to develop reconnaissance level data and will not be used for regulatory compliance assessment; therefore, the use of filtered samples is acceptable. Sampling and analysis methods are described in Section 3.0.

3.0 METHODOLOGY

Methodology and procedures presented in this plan were developed using three primary documents as guidance. These include:

- Groundwater Sampling and Monitoring with Direct Push Technologies (USEPA, 2005);
- Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations (ASTM, 2005a);
- Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers (ASTM, 2005c); and
- Standard Guide for Direct Push Ground Water Sampling for Environmental Site Characterization (ASTM, 2005b).

In addition, experience at the site, in particular information gathered from drilling in alluvial areas and other professional experience with direct-push programs, have been considered in developing this program. The standard operating procedures presented in MWH, 2005 and 2007a will also be utilized as applicable.

This plan provides the guidance for the field program. However, this program is at the reconnaissance level and needs to be adaptable to the subsurface conditions encountered. A previous direct-push program has not been attempted at the site that can be used to help identify an optimal methodology or even the likely success of the program. Therefore, the direct-push contractor and hydrogeologist overseeing the program may need to use some latitude to adapt to the conditions encountered. Any modifications made to the procedures or changes in equipment presented herein will be documented and are subject to Agency/Tribal approval prior to implementation when practicable. At all times, the best practicable sampling procedures for obtaining quality representative samples will be used given the hydrogeologic conditions encountered.

3.1 SITE ACCESS AND AUTHORIZATION

Prior to mobilizing into the field, P4 will arrange for authorization to enter and conduct the scope of work on all public and private land. It is assumed that all locations will be physically accessible by the truck-mounted direct-push rig and supporting vehicles; no road improvements will be required. It will be the responsibility of P4 to coordinate access to an area with obstructions (e.g., fences or berms), if alternate routes are not an option.

3.2 DRILLING AND SOIL SAMPLING

The boreholes will be advanced to first encountered groundwater within the Quaternary and older alluvium and colluvium[1] using a truck-mounted direct-push rig (e.g., Geoprobe®). The direct-push rig utilizes the weight of the rig to push a drive point or coring device into the soil, and can reach depths of up to 100 feet, depending on the size of the rig and the nature of the subsurface soils. The majority of the boreholes for this project will extend to between 10 and 30 feet below ground surface (bgs); some may be shallower and a few may extend slightly deeper if conditions are favorable.

Two methods of identifying and sampling groundwater will be utilized: a coring system or a drive point groundwater sampler. The Stage 1 boreholes will be cored, and the Stage 2 boreholes will largely be drive-point samples, but may be cored if additional data is needed at the sample location.

[1] For ease of discussion colluvium is grouped with alluvium in this document.

The first method utilizes a soil coring system, which allows the collection of soil cores in three to five-foot intervals. The preferred method will be a dual-tube sampling method (ASTM, 2005a) where samples can be extracted in an inner core tube while an outer tube is left in place. This will allow for the highest level of scrutiny for the presence or absence of groundwater. This method is somewhat slower than the drive-point method, but has two advantages. One advantage is the ability to closely examine the soil core for the presence or absence of groundwater. The second advantage is that since the soil core system cuts the soil and removes material, it is more effective at exposing groundwater and allowing recharge into the borehole in low-permeability formations. The drive point system displaces and pushes soil out into the formation, which can reduce the rate or volume of groundwater recharge into the borehole.

The disadvantages of the coring system are that it is somewhat slower, and does not filter the water sample by way of a screen. Groundwater samples will be collected by extracting the inner sampling tube and allowing the outer tube to fill with water, and will be collected with a bailer or pump as described in USEPA (2005). In some locations, the outer tube may be partially extracted to expose specific water bearing intervals identified in the core. If needed, a temporary well screen may be used in the borehole. This screen and riser pipe would be placed through the outer tube, and then the tube partially extracted to expose the screen to the formations of interest.

Core samples will be logged and borehole logs generated for each Stage 1 direct-push location and Stage 2 direct-push locations that are cored. Select portions of the saturated zone of each core sample will be collected and archived at a secure location provided by P4. If needed, these archived samples can be analyzed at a later date to assess material properties, such as grain size and hydraulic characteristics of the shallow alluvial aquifer material. Archived samples will not be tested for selenium or other potential contaminants of concern.

The second method will utilize a drive point with a stainless steel sealed screen system (ASTM, 2005b) that is covered during drilling and then can be exposed at the target interval for groundwater sampling (see Section 3.3). This method does not recover any soil, and therefore requires one to initially predict the depth to groundwater, and then once the target depth is reached, the screen can be exposed. If no water is present, the drive point can be advanced further, or pulled up to a shallower depth, to find groundwater. This method will be used in Stage 2 boreholes where the depth to groundwater can be reasonably predicted based on Stage 1 borings or other information (e.g., evidence of shallow groundwater like spring discharges). The drive-point method will be utilized whenever possible to reduce the drilling time.

After drilling and sampling are complete in each borehole, the hole will be filled with granular bentonite to above the water table. The ground surface around each borehole will be restored to match the existing ground cover.

3.3 PREPACKED WELL SCREEN INSTALLATION AND DEVELOPMENT

Several direct-push borehole locations will be constructed as small diameter monitoring wells (ASTM, 2005c). These wells will consist of 1.5-inch by 2.5-inch OD prepacked well screen. The assembly consists of PVC pipe surrounded by environmental grade sand contained within a stainless steel wire mesh cylinder. The inner component of the prepacked screen is a flush-threaded, 0.5-inch Schedule 80 PVC pipe with 0.01-inch slots. Stainless steel wire mesh with a pore size of 0.011 inches makes up the outer component of the prepack. The space between the inner slotted pipe and outer wire mesh is filled with 20/40 mesh silica sand. Either 3-foot or 5-foot sections will be used. Prepacked wells will be installed and developed in accordance with ASTM documents located in Appendix B.

3.4 GROUNDWATER SAMPLING

Groundwater samples will be collected in one of three ways: using the stainless steel screen of the drive-point system, through the macro-core borehole, or from prepacked screens installed in select Stage 2 direct-push boreholes. The stainless steel screen point (e.g., a Geoprobe® Screen Point 15 or 16) groundwater sampling system is a protected screen sampler with a retractable sheath and an expendable drive point. While the sampler is advanced to depth, O-ring seals at each rod joint, the drive head, and the expendable drive point provide a watertight system preventing formation water from entering the screen before deployment and assures sample integrity. Once the desired sampling interval is reached, extension rods are sent down hole until the leading rod contacts the bottom of the sampler screen. The tool string is then retracted up to 44 inches while the screen is held in place with the extension rods. As the tool string is retracted, the expendable point is released from the sampler sheath. The tool string and sheath may be retracted the full length of the screen or as little as a few inches if a small sampling interval is desired. Once the screen is exposed and groundwater has recharged into the sampler, the groundwater sample will be collected from the screen point using dedicated polyethylene tubing lowered into the hole and a peristaltic pump at the surface.

In boreholes where a dual tube sampler is used, the inner soil sampling tube will be extracted and the outer tube allowed to fill with water. The water will then either be extracted with a peristaltic pump or mini-bailer. If a specific water bearing zone is identified in the core, then the outer tube can be retracted to a point above the target zone. If the borehole collapses or excessive turbidity is an issue then a small well screen and riser pipe may be inserted through the outer tubing.

If the borehole yields sufficient water without affecting the integrity of the borehole, some water will be produced in an attempt to develop the location and remove sediment, and low-flow purging and sampling methodology will be utilized, as practicable. However, groundwater yields are expected to be generally low and the micro-purging or passive sampling procedure will be applied at most locations (USEPA, 2005). This method is also most applicable to the sampling tools that will be utilized. With this method minimal water is produced with the goal of collecting the water within the screened interval of the sampler. With the direct push program sampling will occur almost immediately after exposure of the groundwater bearing zones, and as such, a stagnant water column in the borehole will not be a concern.

At direct-push locations where prepacked well screens have been installed, groundwater will be extracted with either a peristaltic pump or mini-bailer.

Sampling will be conducted so that samples will be collected in a continuous sequence with the advancement of the borehole (i.e., samples will not be collected after a borehole has stood open overnight). A possible exception could occur if the only water bearing zones located yield water so slowly that an extended period of time is required for sufficient water volume to collect in the borehole for sampling. In such a case, a temporary well screen and riser may be left in the borehole, and sampling may be attempted on the following day.

All the groundwater samples will be field filtered using a disposable 0.45-micron (μm) filter prior to filling the sample containers. Field filtering will be used to reduce artifactual turbidity produced due to the use of sampling points without filter pack or, in most cases, limited development. This will provide comparable samples without the bias that may be introduced from varying amount of aquifer matrix in the sample. If the samples are collected with a pump, an in-line disposable filter will be placed on the pump discharge line and the groundwater sample will be collected directly into the sample container from the filter discharge. If the samples are collected with a bailer, the sample will first be transferred to a clean container, and then filtered using a peristaltic pump equipped with Teflon tubing and an in-line 0.45 μm disposable filter. The inlet of the pump tubing will be placed in the groundwater sample and the sample will be pumped through the filter and collected into the sample container from the filter discharge. The filters will be discarded after each use.

3.5 SLUG TESTING

Slug testing will be completed using a Geoprobe® pneumatic slug test kit. Slug testing methods are outlined in the standard operating procedures located in Appendix A. Slug testing will be completed at select sites in each flow path based on the conditions encountered at each direct-push location. Boring logs completed during the installation of the prepacked well screens will be reviewed to aid in the selection process. At a minimum one direct-push location in each flow path will be slug tested to assess the hydraulic conductivities within the shallow alluvium and upper Dinwoody Formation.

3.6 WELL ABANDONMENT

Idaho Department of Water Resources (IDWR) regulation (IDAPA 37.03.09.12a) for well abandonment will be followed if prepacked direct-push boreholes or piezometers require abandoning during this field effort. In general the procedure for abandoning the aforementioned is as follows:

- If practical, the casing will be pulled out of the borehole, otherwise it will be left in place.
- The borehole or casing will be sealed from the bottom up with either bentonite grout, cement grout or cement by using a tremie pipe.

3.7 ANALYTICAL METHODS

Near real time data is the most ideal way to direct a reconnaissance program as presented herein. Field methods for analyzing selenium on or near the site were assessed, and it was found that a suitable method was not available for a project this size. Indicator parameters that could be measured in the field were also considered. A suitable parameter that reliably correlates with selenium concentration has not been identified. Therefore, the program will have to rely on direct laboratory analysis of selenium. Rush turnaround may be considered for the early portion of the program after consultation with the laboratory (the turnaround time available will vary depending on how much work the lab has in-house).

The samples will be laboratory analyzed for selenium as the key indicator parameter, using analytical method SM3114 B, AA-Hydride. This method obtains an estimated detection limit of 0.001 mg/L. The analysis will be performed by ACZ Laboratories.

ACZ Laboratories, Inc.
30400 Downhill Drive
Steamboat Springs, CO 80487
Phone: (800) 334-5493

All filtered groundwater samples will be field preserved with a 0.5% solution of nitric acid to lower the sample pH to less than 2. The samples will not be preserved prior to filtering. The samples will be placed on ice for shipping to the laboratory. The holding time is 180 days.

3.8 SURVEYING

Each borehole location and other pertinent features observed in the field will be surveyed using a hand-held global positioning system unit (GPS). A GPS with a WAAS-capable receiver will be used, which typically will provide an accuracy of less than 10 feet.

All measurements will be referenced to the State Plane Coordinate System, North American Datum 1983. During surveying, the northing and easting will be stored in the GPS unit and then downloaded onto a computer at the end of each day. The measurements will also be recorded in a bound field notebook. The GPS unit will be checked daily for accuracy at a control point or benchmark with a known northing and easting.

3.9 FIELD QUALITY CONTROL SAMPLES

Blind sample duplicates and equipment rinsate samples will be collected at a rate of one per 20 samples, if practicable. The blind duplicate samples will be collected from the same borehole using the same methods as the primary sample. The samples will be given a different sample ID, which along with date, time and team members will be recorded in the field log book. Additionally, a separate list of blind duplicate samples and their associated primary samples will be maintained, to ensure that the correct blind and primary samples pairs are recorded. Collection of duplicate samples may be limited to boreholes with sufficient yield to provide duplicate samples within a reasonable time.

To the extent possible and practical, dedicated sampling equipment will be used (e.g., new plastic peristaltic pump tubing). However, equipment rinsate blanks will be prepared at the Site by passing laboratory-provided reagent water of known quality through decontaminated non-dedicated sampling equipment (e.g., the stainless steel screen). In addition to collection of a rinsate sample for every 20 primary samples, an equipment rinsate sample will be collected just before final use of any non-dedicated sampling equipment. The samples will be submitted to the laboratory and analyzed for the same analytes that are specified for associated field samples.

The field log will identify the team members, date, and sampling area and location. This identification procedure will associate the blind duplicate and equipment rinsate samples with a specific team and sample location.

3.10 DECONTAMINATION PROCEDURES

All non-disposable or non-dedicated sampling equipment will be cleaned and decontaminated prior to use at each location. The sampling equipment will be decontaminated using a pressure washer, if available. Otherwise, the equipment will be decontaminated as follows:

- Wash the equipment in low- or non-phosphate detergent (e.g., Alconox® or Liqui-Nox® solutions made as directed by the manufacturer);
- Rinse with potable water; and
- Rinse twice with laboratory-grade deionized or distilled water.

The rinse water will be dispersed on the mine site away from surface water drainages where it will either evaporate or infiltrate back into the ground.

3.11 SAMPLE CONTAINERS

Groundwater samples will be sealed in 250 milliliter polyethylene bottles supplied by the laboratory. Chemical preservative (0.5% nitric acid) will be added to the sample containers by the laboratory prior to sampling. After collection, samples will be properly stored to prevent degradation of the integrity of the sample prior to its analysis and analyzing the sample within the prescribed holding time. Sample preservation and holding times are to be maintained from the time of sampling until the time of analysis. Each cooler will contain a chain-of-custody, as described in Section 3.10.4, that documents the samples in that particular cooler.

Soils samples recovered from direct-push boreholes will be placed in labeled quart-size zip-lock bags. Labels will include the borehole number, date sampled, and sample interval (referenced from the ground surface). The soil samples will then be placed in plastic containers and transferred to a storage location at a Monsanto facility for archiving.

3.12 DISPOSAL OF INVESTIGATION DERIVED WASTE

Generation of investigation derived waste (IDW), such as equipment decontamination wastewater, rinsate, soil cuttings, sample containers, and personal protective equipment (PPE) will be minimal. IDW will be stored in 55-gallon drums, or plastic garbage bags (PPE or related garbage). The IDW will be temporarily stored at a central location, as directed and authorized by P4. The minimal soil cuttings, rinse water and produced water will be dispersed at the sample site. Water will be dispersed away from surface water courses. The coordination and arrangement of off-site transport and disposal of the IDW, if required, will be the responsibility of P4.

3.13 SAMPLE DOCUMENTATION AND SHIPMENT

3.13.1 Field Notes

The on-site hydrogeologist/environmental scientist will use a weather-resistant, bound, survey-type field logbook with numbered, non-removable pages to record in black or blue indelible ink all field activities. Daily information entered in the logbook will include:

- Dates and times
- Name and location of the work activities
- Precise location identification numbers
- Northing and easting coordinates
- Weather conditions
- Personnel, subcontractors and visitors on site
- Sample locations and methods (including sampling equipment)
- Time of sample collection, and sample depths
- Samples submitted to the laboratory for analyses
- Sample type (e.g., groundwater, rinsate water, or blind duplicate)
- Name of carrier transporting the sample (e.g., name of laboratory and shipping carrier)
- Photograph numbers and descriptions (if applicable)
- Description of decontamination activities
- Schematic drawings of sample locations (if not done on field forms)
- Any deviations from the work plan
- Health & Safety meetings, including topics discussed and attendees
- Accidents, including near misses
- Other relevant observations as the field work progresses
- Problems and corrective actions
- Field equipment calibration methods
- Investigation derived waste

At the end of each field day, the project field book will be dated and signed by the field person who took notes during the day. If the entire page is not used a line will be drawn through the unused portion of the page. If pages are accidentally skipped, a line will be drawn through the entire page. All corrections will be made by drawing a line through the erroneous information and initialing the change. "White-out" or its equivalent will not be used.

3.13.2 Sample Identification

All samples will be labeled in a clear, precise way for proper identification in the field and for tracking in the laboratory. The samples will have identifiable and unique numbers. At a minimum, the sample labels will contain the following information:

- Facility name
- Sample number
- Sample depth
- Date of collection
- Time of collection
- Method of sample preservation

A coding system will be used to uniquely identify each sample collected. The system will allow for quick data retrieval and sample tracking.

3.13.3 Labeling

The sample designation (Sample ID) will be recorded on the sample labels, logbook, sample tracking sheet(s), and chain-of-custody forms, and will comprise three parts or fields.

1. Part 1 will designate the mine and sampling area:

    - EnochA
    - EnochB
    - HenryC
    - HenryD
    - BallardE
    - BallardF
    - BallardG

2. Part 2 will be a field that begins with alphabetic characters that identify the type of sample:

    - GW = primary and duplicate groundwater samples
    - EQ = equipment rinsate samples

3. Three digits will follow the alphabetic character(s) and will be sequential (e.g., "001" for the first sample location collected, "002" for the second, "003" for the third, etc.). Samples will be numbered sequentially for each type of sample collected (i.e., primary sample, equipment rinsate sample). The sample number for each primary sample will correspond to the borehole location ID number. Primary and equipment rinsate sample numbers will start with 001 and go up to 299, if required. Blind duplicate sample numbers will start with 300 and go up from there.

As an example, sample designation BallardG-GW004 is the 4th groundwater sample collected overall, and was collected from the Ballard Mine, Area G, borehole number 004 (BH004). The first blind duplicate sample collected would be labeled BallardG-GW300.

Borehole location ID numbers will start with 001 and go up sequentially from there, regardless of the sample area designation, or the mine. For example, if there are 30 samples in Enoch Valley Area A, then the last borehole there will be numbered BH030, with corresponding groundwater sample number EnochA-GW030. Then the first borehole in Enoch Valley Area B, assuming it is sampled next, will be numbered BH031, with corresponding groundwater sample EnochB-GW031. Then the first borehole at the Henry Mine Area C, assuming it is sampled next, will be the next sequential number after the last borehole in Enoch Valley Area B (XXX), with corresponding sample HenryC-GWXXX. Blind duplicate and rinsate sample numbers will not correspond to borehole numbers, and will simply start at '300' and go up from there, regardless of the area or location.

If the groundwater sampling program is extended outside of the aforementioned designated areas, the samples collected in the area will receive a sample ID based on the designated area closest to the sample location. For example, if a sample is collected in the area north of Enoch Valley Area A, labeling for those samples will follow the convention for samples collected from Enoch Valley Area A. All designated area boundaries adjusted during the field work, due to additional sample collection, will be shown on the maps included in the final report.

3.13.4 Chain-of-Custody

Each sample will be properly documented to facilitate timely, accurate, and complete analysis of data. The documentation system is used to identify, track, and monitor each sample from the point of collection through final data reporting. Chain-of-custody protocol will be implemented and followed for all samples. A sample is considered to be in a person's custody if it is: 1) in a person's physical possession, 2) in view of the person after taking possession, or 3) secured by that person so that no one can tamper with it.

Chain-of-custody forms will be used to ensure that the integrity of samples is maintained. Each form will include the following information:

- Sample number
- Date of collection
- Time of collection
- Sample depth
- Analytical parameter
- Method of sample preservation
- Number of sample containers
- Shipping arrangements and air bill number, as applicable
- Recipient laboratories
- Signatures of parties relinquishing and receiving the sample at each transfer point

Whenever a change of custody takes place, both parties will sign and date the chain-of-custody form, with the relinquishing person retaining a copy of the form. An exception to this is the transportation company. The party that accepts custody will inspect the custody form and all accompanying documentation to ensure that the information is complete and accurate. Any discrepancies will be discussed with the MWH project manager and noted on the chain-of-custody form.

3.13.5 Packaging and Shipment

After collection, samples will be properly stored to prevent degradation of the integrity of the sample prior to its analysis. As applicable, this includes the use of the appropriate chemical preservative (0.5% nitric acid), storing the sample in an appropriate container, and analyzing the sample within prescribed holding times. Sample preservation and holding times are to be maintained from the time of sampling until the time of analysis.

Samples will be sealed in the appropriate sampling container. Sample containers will be placed in clean protective foam or bubble pack sleeves, as appropriate. The caps of all sample bottles shall be checked for tightness to prevent sample leakage during transport. Care will be taken to prevent over-tightening and breakage of bottle caps. Custody seals will be placed on each cooler for shipment such that it must be broken to open the cooler.

The samples will be packed securely in an ice chest or other appropriate container, and samples will be preserved in accordance with the specification. Sufficient packing material will be placed in each ice chest to minimize the potential for sample bottles to shift and become damaged or broken during shipment. Packing material may include bubble pack or foam material. The drain plug on the shipping container will be closed and sealed on the inside and outside with duct tape.

Sampling personnel will inventory the sample bottles from the Site prior to shipment to ensure that all samples listed on the chain-of-custody form are present. All bottles collected from a specific sampling interval will be packed and shipped together in the same shipping container. The originals of the analysis request and chain-of-custody forms will be sealed in a waterproof plastic bag and placed inside the shipping container prior to sealing of the container. The cooler will be taped shut using strapping tape over the hinges and custody seals placed across the top and sides of the cooler lid. One or more custody seals will be signed, dated, and placed on the front and back of the sample cooler prior to transport. Clear tape will be placed over the custody seals to prevent inadvertent damage during shipping. The tape should not allow the seals to be lifted off with the tape and then reaffixed without breaking the seal.

All samples designated for off-site laboratory analysis will be packaged and shipped in accordance with applicable U.S. Department of Transportation regulations. Samples will be shipped no faster than 2-day air or ground transportation using FedEx or UPS. The lead team member will maintain shipment tracking numbers and verify that the shipments have reached their destination at the appropriate time.

3.14 HEALTH AND SAFETY PROGRAM

The work conducted as per this work plan will follow the *Comprehensive Site Investigation, Health and Safety Plan - Final* (MWH, 2004; HSP), as well as applicable updates to the HSP (MWH, 2007a and 2007b). The Health and Safety Plan was prepared to establish the responsibilities, requirements, and procedures for protecting MWH personnel and subcontractors conducting an investigation of surface water, sediment, fish tissue, habitat, groundwater, surface soil, and vegetation quality. This HSP was prepared to provide assigned field personnel with a safe working environment as investigation proceeds. Specifically, the HSP has been developed to minimize the potential for job-related injuries and illnesses, and to prevent job-related injuries and illnesses from occurring.

A fundamental principle of industrial safety and loss prevention is that most accidents that cause injury, illness, or property damage are preventable. Investigations of the causes of industrial accidents and illnesses have demonstrated that most injuries or illnesses are the result of unsafe acts or conditions. Thus, minimizing industrial accidents and illnesses can be accomplished by recognizing, evaluating, and controlling unsafe acts and conditions.

In addition to the information contained in the HSP, MWH has developed Industrial/Hazardous Waste Operations Health and Safety Policies and Procedures that form the basis for safe employee work practices. A copy of the policies and procedures manual will be available in the field to project personnel. Employees are required by these policies and procedures to employ safe work practices and comply with applicable MWH requirements, as well as the applicable requirements of the agencies responsible for regulating industrial health and safety, including the OSHA and MSHA.

3.15 DATA QUALITY OBJECTIVES FOR GROUNDWATER

Medium-specific data quality objectives (DQOs) are not isolated objectives. For a holistic discussion, please see Section 3.1 of the Ballard, Henry, and Enoch Valley mines work plans (MWH 2004a). This direct push plan was developed as a cost- and time-effective way to satisfy groundwater-related DQOs. For the convenience of the reader, these groundwater-related DQOs are summarized here.

Step 1 – State the Problem

- Contaminants of potential concern, primarily selenium, are leaching at concentrations of potential concern from waste rock into surface waters.

- Most of the selenium transport occurs during spring runoff and occurs from surface runoff and shallow interflow, but at least some is occurring via groundwater.

Step 2 – Identify the Decision

- Some groundwater monitoring wells on or near Monsanto's three historic phosphate mines have selenium concentrations elevated above regional background levels (as defined by regional surface water background). The decision is to determine whether the groundwater is elevated above the groundwater standard (0.050 mg/L) and if groundwater is contributing to surface water bodies such that the surface water quality standard (0.005 mg/L) is being exceeded. The decision therefore involves determining if the groundwater quality and hydraulics lead to either standard being exceeded and if so, the spatial extend of the exceedance.

Step 3 – Identify the Inputs to the Decision

- Some groundwater monitoring wells on or near Monsanto's Ballard Mine appear to have selenium concentrations in excess of the relevant compliance level of 0.050 mg/L. (Note: Validation of the data is not yet complete at this time, so this statement must be regarded as preliminary.) The data collected from the direct-push investigation will be used in conjunction with the data collected from the existing monitoring wells to estimate or predict the spatial extent of the contaminated groundwater, if found, and the probable concentrations within the bounds of the spatial extent.

Step 4 – Define the Boundaries of the Study

- During planning in 2004, the site investigations for the three mines were expected to occur over a two-to-three year period. Now in the fourth year, the temporal boundaries have been expanded considerably, due to the first task of the second phase groundwater investigation taking two years to complete.
- The boundaries of significant groundwater contamination are defined by compliance thresholds.

Step 5 – Develop a Decision Rule

- The relevant compliance threshold linked to protection of human health is 0.050 mg Se/L in groundwater.
- The relevant compliance threshold linked to protection of ecological health is 0.0050 mg Se/L in surface water (where groundwater contributions are responsible for elevating surface water concentrations).

Step 6 – Specify Tolerable Limits on Decision Errors

- The traditional type I error rate is 0.050. The traditional type II error rate is 0.20. It is usually the probability that one with reject H_0 [the null hypothesis] when it is in fact true (the Type I error) that is of most concern. The largest acceptable risk of this error's occurrence is commonly set at $\alpha = 0.05$. The five percent level of significance is only a convention, but anyone who uses a higher probability level should be prepared for the suspicion that the level was chosen *after* determining that the results were not quite significant at $\alpha = 0.05$.

  "[F]or any given sampling and statistical analysis design, lowering the Type I error level α will increase the Type II error level β, which is the probability of concluding that H_0 is true when in fact it is not. ... There is always a tradeoff, and the only way to reduce one error level without increasing the other is to improve the design." R.H. Green, 1979, *Sampling Design and Statistical Methods for Environmental Biologists*, John Wiley & Sons, New York.

  And,

"Type I and II Error Rates.

"First, statistical significance. The difference is statistically significant, by definition, if the 95% confidence interval does not overlap zero, or if the p value for the effect is less than 0.05. Values of 95% or 0.05 are also equivalent to a Type I error rate of 5%: in other words, the rate of false alarms in the absence of any...effect will be 5%. We don't have any choice here. It has to be 5%, or less preferably, but most researchers opt for 5%.

"Now, what about being sure that the effect will turn up? In other words, if the effect really [exists at the smallest level of interest], how sure do we want to be that the difference observed in our sample will be statistically significant? We don't have any choice here, either. We have to be at least 80% sure of detecting the smallest effect. To put it another way, the power of the study to detect the smallest effect has to be at least 80%. Or to put it yet one more way, the Type II error rate--the rate of failed alarms for the smallest effect--is set at 20% or less." www.sportsci.org/resource/stats/ssdetermine.html.

And,

"Many statistics textbooks present a point of view that is common...that α, the Type I error rate, must be kept at or below .05, and that, if at all possible, β, the Type II error rate, must be kept low as well. 'Statistical power,' which is equal to 1-β ['statistical confidence' is equal to 1-α], must be kept correspondingly high. Ideally, power should be at least .80 to detect a reasonable departure from the null hypothesis." sunsite.univie.ac.at/textbooks/statistics/stpowan.html.

Step 7 – Optimize the Design for Obtaining Data

- This direct push plan was developed as a more optimal approach to characterizing the extent of shallow groundwater contamination.

3.16 CONTINGENCY PLAN

There is a possibility that the direct-push sampling method will not be successful in all areas either because the depth to groundwater is too deep or because sediments yield too little groundwater. Where groundwater sampling is not successful due to limitations of the direct-push sampling method, shallow alluvial monitoring wells will be installed by using either hollow-stem auger or sonic drilling methods. Shallow alluvial monitoring well installation details for both methods are provided by reference (see MWH, 2007a).
It is not possible to provide detailed responses to all the various scenarios that may occur in the individual investigation areas. This is because there are many possibilities for partial success that would provide sufficient data to address the data gap, or provide data for locating strategically-placed conventional shallow monitoring wells to complete the investigation. A determination of completeness may also require assessing the analytical results.

Weekly status reports will be provided to Agency/Tribal representatives. The status reports will contain a summary of the direct-push borehole installation activities for the previous week. The weekly status reports will include details regarding the rationale for changing, adding, or eliminating direct-push borehole locations. As each area is completed, the percent of completion of the plan will be reported in the summaries along with recommendations for addressing any data gap that remains due to incomplete data collection. These recommendations may range from no further action to additional conventional well installation depending upon the area and results obtained.

The direct-push program will require investigating groundwater conditions at over 100 locations in a very short time period. Agency/Tribal representatives will need to contribute to the program on a weekly basis if the program is to be successful. Agency/Tribal representatives will likely be required to visit the mine sites on several occasions during the duration of the field activities to meet with P4, discuss potential changes in the work plan, observe the field conditions that are requiring the potential changes, and provide timely concurrence or offer viable recommendations.

4.0 REFERENCES

ASTM International (ASTM), 2005a. *Standard Guide for Direct-Push Soil Sampling for Environmental Site Characterizations*. Designation: D 6282-98 (Re approved 2005), 18 p.

ASTM International (ASTM), 2005b. *Standard Guide for Direct-Push Ground Water Sampling for Environmental Site Characterization*. Designation: D 6001-05, 16 p.

ASTM International (ASTM), 2005c. *Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Material*. Designation D 6725-05, 15 p.

MWH, 2007a. *Monitoring Well Installation Technical Memorandum* (Phase II Groundwater Work Plan). February 2007.

MWH, 2007b. *2007 & 2008 Surface Water Monitoring Plans – Final*. P4 Production, Southeast Idaho Mine Specific Selenium Program. May, 2007.

MWH, 2005. *Final 2005 Phase II Supplemental SI Groundwater Work Plan* (Phase II Groundwater Work Plan). April 2005.

MWH, 2004a. *P4 Production Southeast Idaho Mine-Specific Selenium Program 2004 Comprehensive Site Investigation Final Work Plans for Ballard, Henry and Enoch Valley Mines* (2004 SI Work Plan), March 2004.

MWH, 2004b. *Comprehensive Site Investigation, Health and Safety Plan – Final*, April 2004.

U.S. Environmental Protection Agency (USEPA), 2005. *Groundwater Sampling and Monitoring with Direct Push Technologies*. OSWER No. 9200.1-51, EPA 540/R-04/005, August 2005, 67 p.

DRAWINGS

APPENDIX A

STANDARD OPERATING PROCEDURES

(Geoprobe® Systems)

APPENDIX B

ASTM DOCUMENTS